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Behavioral status and sucking of late preterm newborns undergoing phototherapy

Estado comportamental e sucção de recém-nascidos pré-termo tardios submetidos a fototerapia

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ABSTRACT

Purpose: To evaluate the behavioral state of late preterm newborns undergoing phototherapy and its association with non-nutritive sucking. **Methods:** Cross-sectional study, carried out in a public teaching maternity hospital, a reference in high-risk pregnancy and part of the Baby-Friendly Hospital Initiative. Convenience sample, consisting of 60 late preterm newborns, cared for in rooming-in, divided into two groups. One group consisted of 30 newborns under phototherapy (case group) and another group with 30 newborns who were not under phototherapy (control group). Sample characterization data were obtained through anamnesis and collection from medical/hospital records. The assessment of behavioral status and non-nutritive sucking was carried out using the Preterm Oral Feeding Readiness Assessment Scale. Analyzes were performed using Jamovi (version 2.4.1). A significance level of 5% was adopted for all analyses. **Results:** There was a significant difference in that the newborns in the case group had lower scores for behavioral organization and non-nutritive sucking. There was also a significant association between behavioral status and non-nutritive sucking in both groups. **Conclusion:** It was concluded that late preterm newborns undergoing phototherapy had lower scores in the state of behavioral organization and non-nutritive sucking responses when compared to late preterm newborns who were not undergoing treatment. An association was observed between non-nutritive sucking responses and the state of behavioral organization in both groups.

Keywords: Phototherapy; Infant; Premature; Sleep; Sucking behavior; Rooming-in Care

RESUMO

Objetivo: avaliar o estado comportamental de recém-nascidos pré-termo tardios sob a fototerapia e sua associação com a sucção não nutritiva. **Métodos:** estudo transversal, realizado em uma maternidade pública de ensino, referência na gestação de alto risco e integrante da Iniciativa Hospital Amigo da Criança. Amostra por conveniência, composta por 60 recém-nascidos pré-termo tardios, assistidos em Alojamento Conjunto, divididos em dois grupos: um grupo composto por 30 recém-nascidos sob fototerapia (grupo caso) e outro grupo com 30 recém-nascidos que não estavam sob fototerapia (grupo controle). Os dados de caracterização da amostra foram obtidos por meio de anamnese e de coleta em prontuário médico/hospitalar. A avaliação do estado comportamental e da sucção não nutritiva foi realizada por meio da *Preterm Oral Feeding Readiness Assessment Scale*. As análises foram realizadas pelo *software* Jamovi (versão 2.4.1). O nível de significância de 5% foi adotado para todas as análises. **Resultados:** verificou-se diferença significativa em que os recém-nascidos do grupo caso apresentaram escores inferiores no estado de organização comportamental e de sucção não nutritiva. Observou-se, ainda, significância na associação entre o estado comportamental e a sucção não nutritiva nos dois grupos. **Conclusão:** recém-nascidos pré-termo tardios em fototerapia apresentam menores escores no estado de organização comportamental e nas respostas da sucção não nutritiva quando comparados aos recém-nascidos pré-termo tardios que não estavam submetidos ao tratamento. Observou-se associação entre as respostas da sucção não nutritiva e o estado de organização comportamental nos dois grupos.

Palavras-chave: Fototerapia; Recém-nascido prematuro; Sono; Comportamento de sucção; Alojamento Conjunto

Study carried out at Maternidade Escola Januário Cicco – MEJC, Universidade Federal do Rio Grande do Norte – UFRN – Natal (RN), Brasil.
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INTRODUCTION

A late preterm (LPT) infant is one born with a gestational age between 34 and 36 weeks and 6 days[1]. LPT infants are more prone to neonatal complications, including low APGAR scores (appearance, pulse, gestures, activity, and breathing), infection, respiratory distress and failure, feeding difficulties, poor growth, hypoglycemia, hyperbilirubinemia, and hypothermia. These morbidities result in prolonged hospitalization and increase the risk of readmission after hospital discharge[1-3].

Phototherapy is the first-choice treatment for neonatal jaundice, as it reduces bilirubin concentrations through several photochemical reactions that enable efficient excretion of bilirubin[4]. Although widely used, adverse effects are associated with it, such as molecular changes due to phototherapy, interference in the mother-child relationship, thermal and hydroelectrolytic imbalance, bronze baby syndrome, skin lesions, hematologic alterations, paralytic ileus, patent ductus arteriosus, ocular effects of phototherapy, neoplasms, allergic diseases, changes in the circadian rhythm[5], and an increased risk of childhood seizures[6].

The circadian rhythm, among the abovementioned adverse effects, ensures adaptation to the 24-hour day-night cycle and determines the metabolic, physiological, and behavioral reactions, which are generally in the process of adjustment in premature babies[7]. The behavioral state comprises the states of consciousness that range from deep sleep to crying[8]. In general, sleep states are divided into sleep (active and calm), non-sleep (active and calm wakefulness), and indeterminate sleep (transition between sleep states)[9-11]. Since the behavioral state is associated with the performance of preterm (PT) infants in readiness for oral feeding[12], this factor should be considered both in the speech-language-hearing assessment and at the time of breastfeeding[13].

The motor system encompasses muscle tone, posture, and voluntary and involuntary movements. Motor system stability in infants is indicated by behaviors such as harmonious posture, balance between flexion and extension, absence of hypothermia or hypertonia, and synchronous and harmonious limb movements[8]. Readiness for breastfeeding in infants is known to be associated with a state of alertness, and so is handgrip, the oral reflexes of rooting and sucking, and bringing the hands to the midline and the face[12].

Speech-language-hearing pathologists can play an essential role in the care of infants, being responsible for evaluating the anatomy and physiology of the oral cavity, the biomechanics of sucking, swallowing, and breathing, and the sensory and motor aspects of the cranio-orofacial system. They are also qualified for specific diagnoses of changes or immaturity in the stomatognathic system and its oral functions or dysfunctions and establish efficient breastfeeding, whenever possible and desired by the family[14].

Phototherapy is believed to influence behavioral states that favor infant feeding. However, few studies address the behavioral state of PT infants undergoing phototherapy[15]. Therefore, this study aimed to assess the behavioral state of LPT infants undergoing phototherapy and its association with non-nutritive sucking (NNS).

METHODS

This is a cross-sectional study, developed at the Januário Cicco Maternity School, Federal University of Rio Grande do Norte - MEJC/UFRN, Natal (RN), Brazil, from June 2022 to June 2023. The research was approved by the Research Ethics Committee, under evaluation report number 6.169.294. The parents/guardians agreed to participate in the research and signed an informed consent form.

The sample consisted of 60 LPT infants, chosen by convenience during care in the said period and divided into two groups, according to the use of phototherapy. The first group had 30 LPT infants with jaundice undergoing phototherapy (case group), and the second group had 30 LPT infants not undergoing phototherapy (control group). The following were considered eligible for the study: infants with a gestational age between 34 and 36 weeks and 6 days, at least 24 hours old, cared for in the rooming-in ward, clinically stable, and on exclusive oral feeding. The following were excluded: infants with intracranial hemorrhage; craniofacial malformation; syndrome; heart disease; abnormal lingual frenulum; 5-minute APGAR score below 7; and requiring care in a neonatal intensive care unit.

Infant characterization variables were collected by analyzing their medical records, considering sex, gestational age at birth, corrected gestational age, birth weight, weight on the day of assessment, weight difference between birth weight and current weight, low birth weight, adequacy between birth weight and gestational age at birth, type of delivery, use of supplements, and time of phototherapy (case group).

The Preterm Oral Feeding Readiness Assessment Scale (POFRAS)[16] assessed the behavioral state and NNS. This protocol was developed and validated in Brazil and includes the following aspects: corrected gestational age; state of behavioral organization (SBO) (state of consciousness, global posture, and global tone); oral posture (lips and tongue); oral reflexes (rooting, sucking, biting, and vomiting); NNS (tongue movement and cupping, jaw movement, suction force, paused sucking, maintaining sucking rhythm with pauses, and alert state); signs of stress; and the infant's corrected gestational age. There are 18 items altogether; a score of 0 to 2 is assigned for each one, totaling 36 points, depending on the responses. The categories approached in this study were the SBO, with scores ranging from 0 to 6, and NNS/signs of stress, with scores ranging from 0 to 16.

The assessment took place 30 minutes before feeding. The infant was positioned in lateral decubitus inside the hospital crib to observe the SBO. Then a gloved little finger was inserted into their oral cavity to verify NSS, with the palm facing down and the other hand resting on the infant's back. The NNS test lasted 1 minute, timed with a digital stopwatch.

The assessments were performed by three speech-language-hearing pathologists with expertise in oral-motor function, assisting in the rooming-in ward. All of them were previously trained and fully mastered the application of the protocol. Thus, the same researchers conducted the observations, interventions, and records consistently regarding the content and its application. Each infant was assessed only once by the speech-language-hearing pathologist in charge on that day.

The data were stored in a database in Excel®, and the analyses were performed by the Jamovi software (version 2.4.1). In statistical analysis, the nonparametric Mann-Whitney U test

compared the differences between the distributions of categorical variables. The Kendall correlation assessed the relationship between the SBO and NNS per group of patients (case and control). For the Kendall correlation analysis, the values were evaluated according to the Cohen scale: Between 0.10 and 0.30 = weak; between 0.30 and 0.50 = moderate; and greater than 0.50 = strong. The Fisher's exact test was used to evaluate the association between categorical variables when the expected frequencies were less than 5, and the Chi-square test when they were greater than or equal to 5. The descriptive analysis of the variables was performed by the median, interquartile range (Q_1-Q_3), and absolute and relative frequencies. A significance level of 5% was adopted for all analyses.

RESULTS

The sample characterization showed a significant difference between the two groups regarding supplement use (Table 1).

The POFRAS SBO score per group differed significantly between them (Table 2).

The POFRAS NNS score per group also differed significantly between them (Table 3). The correlation between SBO and NNS was positive, moderate, and significant in the case group – $r_\tau(28) = 0.352$, $p < 0.05$ – and positive, strong, and significant in the control group – $r_\tau(28) = 0.568$, $p < 0.01$.

DISCUSSION

This study found a significant difference between the groups in supplement use, SBO, and NNS, and a correlation between SBO and NNS in both groups. It is believed that infants around 34 weeks can coordinate the functions of sucking, swallowing, and breathing[16], although LPT infants are known to perform worse in NNS parameters than full-term infants[17].

The LPT infants in the case group had a greater need for supplementation, either due to difficulty in establishing breastfeeding[18] or as a strategy for the clinical management of jaundice[19]. In the local hospital of the study, supplementation was served in a cup, which is widely used for this purpose, when necessary[20]. However, its excessive use can affect

Table 1. Characterization of infants per group in the study sample

VARIABLES	GROUP		p-value	TOTAL
	Case	Control		
	n = 30	n = 30		n or ME (% or IQR)
Sex, n (%)				
Females	16 (48.5)	17 (51.5)	0.795	33 (100.0)
Males	14 (51.9)	13 (48.1)		27 (100.0)
Type of delivery, n (%)				
Normal birth	19 (57.6)	14 (69.7)	0.194	33 (100.0)
Cesarean section	11 (40.7)	16 (59.2)		27 (100.0)
Adequacy of weight and gestational age at birth, n (%)				
AGA	26 (52)	24 (48.0)	0.872	50 (100.0)
SGA	2 (33.3)	4 (66.7)		6 (100.0)
BGA	2 (50.0)	2 (50.0)		4 (100.0)
Low birth weight, n (%)				
Yes	10 (37.0)	17 (63.0)	0.069	27 (100.0)
No	20 (60.6)	13 (39.4)		33 (100.0)
Supplement use, n (%)				
Yes	20 (67.9)	8 (32.1)	**0.002**[a]	28 (100.0)
No	11 (34.4)	21 (65.6)		32 (100.0)
Gestational age at birth, w	36.0 (1.0)	36.0 (1.0)	0.848	36.0 (1.0)
Corrected gestational age, w	36.0 (2.0)	36.0 (1.0)	0.637	36.0 (2.0)
Birth weight, g	2647 (765)	2460 (556)	0.246	2565 (596)
Current weight, g	2440 (586)	2212 (472)	0.165	2361 (551)
Weight difference, g	-199 (-161)	-162 (-107)	0.636	-188 (139)
Time of phototherapy, d	2.0 (2.0)	----	---	2.0 (2.0)

[a]$p < 0.05$, Mann-Whitney U test

Subtitle: ME = median; IQR = interquartile range; n = number of infants; % = percentage; w = weeks; d = days; g = grams; AGA = adequate for gestational age; SGA = small for gestational age; BGA = big for gestational age

Table 2. Score of the state of behavioral organization in the Preterm Oral Feeding Readiness Assessment Scale per group

VARIABLES	GROUPS		p-value[a]	TOTAL
	Case n = 30	Control n = 30		ME (IQR)
State of behavioral organization	4 (1.0)	6 (1.0)	**<0.001**	5 (2.0)

[a]Mann-Whitney U test

Subtitle: n = number of infants; < = less than; ME = median; IQR = interquartile range

Table 3. Score of non-nutritive sucking in the Preterm Oral Feeding Readiness Assessment Scale per group

VARIABLES	GROUPS		p-value[a]	TOTAL
	Case	Control		ME (IQR)
	n = 30	n = 30		n = 60
Non-nutritive sucking	12 (3.0)	16 (1.0)	**<0.001**	14 (5.0)

[a]Mann-Whitney U test
Subtitle: n = number of infants; < = less than; ME = median; IQR = interquartile range

sucking behavior, hindering the establishment of breastfeeding and causing loss of milk, increased feeding time, and risk of complications[21]. Thus, when the need for supplementation is confirmed, an alternative to the cup would be the Supplemental Nursing System[22].

Infants in the case group had a lower SBO score than those in the control group, which may be associated with the use of phototherapy, as it can negatively impact the circadian rhythm[5]. Changing the circadian rhythms leads to sleep deprivation and interferes with normal sleep consolidation in PT infants, who require more time to adjust to the day/night cycle and sleep more until they reach 37 weeks. Thus, phototherapy can cause lethargy, irritability, and even feeding difficulties[8]. Furthermore, infants undergoing phototherapy have more episodes of crying than those not undergoing phototherapy[23], and evidence indicates that phototherapy can prolong hospitalization, compromise the mother-baby bond, and expose the child to unexpected long-term risks[23,24].

The infant's organization reflects their ability to establish an integrated level of functioning between the physiological and behavioral systems[8]. Motor behaviors favorable to feeding can be characterized as holding their own hands, bringing the hand to the mouth or face, sucking the finger, and making movements with the lips asking to suck[8,25]. On the other hand, behaviors unfavorable to feeding include increased limb tone or disordered activity and trunk contortion or arching[8]. Moreover, the alert state favors feeding the most[12,25,26], whereas the sleep state is unfavorable to feeding[13,26].

Although NNS is observed in PT infants between 28 and 33 weeks[27], LPT infants in the case group had lower NNS response scores than those in the control group. NNS occurs when the infant sucks the thumb or the empty or emptied breast without transferring milk[27, 28]. The NNS pattern is characterized by alternating periods of sucking and pausing. NNS is associated with nutritive sucking and, therefore, better NNS responses result in better oral feeding performance[27].

Another relevant result was the relationship between SBO and NNS in both groups. Behavioral status is related to the infant's readiness for oral feeding[8,13,25], which was observed in the present study. However, the LPT infants in the group submitted to phototherapy had lower SBO and NNS scores. Therefore, LPT infants with behaviors unfavorable to feeding – e.g., difficulty in remaining alert during breastfeeding, difficulty in accepting oral supplements[26], and significant weight loss[29] –, should be carefully assessed concerning their readiness to feed in order to ensure successful oral feeding.

LPT infants in rooming-in wards must receive careful attention, especially those undergoing phototherapy. They may have unfavorable behaviors regarding feeding, possibly compromising their breastfeeding performance or supplementation acceptance, when necessary.

The limited number of studies on the topic can be cited as a limitation of this research. The strengths include observing how the SBO and NNS of LPT infants undergoing phototherapy were established and reflecting on this issue, especially in the Brazilian scenario. Thus, it is important to continuously surveil this population to identify unfavorable feeding behaviors and intervene assertively.

CONCLUSION

LPT infants undergoing phototherapy had lower scores in NNS response and SBO than those not undergoing treatment. NNS responses were associated with SBO in both groups.

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